a tattered badge of pride to ourselves. Here is a weapon, the use of which has far-reaching results that appeal to the imagination with the certain annihilation they inflict. Fellow-curators, grasp your weapon, and, more powerful than Canute, force back the advancing tide!

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INTERNAL SECRETIONS CONSIDERED IN RELATION TO VARIATION AND DEVELOPMENT.

THE so-called internal secretions of glands and other organs consist of products manufactured by them and passed back to the blood. Many of these products are known to be of very great importance to the adult organism; it is possible that they may be of no less importance to the developing organism and that we may here find a clue to some of the unsolved problems of development. Internal secretions have probably been longest recognized in case of the reproductive organs. The effects of castration, of non-development or development of these organs are well known. It has also been generally recognized that the influence of these organs depends on substances formed by them and given to the blood. What these substances are is still unknown, but there can be little doubt that their presence determines the development of other organs and characters, the so-called secondary sexual characters. The long recognized healing effect of removal of the ovary in women suffering from soft bones and the subsequent growth of bone and fatty tissue has been the subject of researches by Curatulo and Tarulli.* These authors concluded that the ovaries produce a substance which oxydizes the organic phosphorus compounds and thus cause their rapid destruction. The removal of the ovaries would seem to remove the destroying substance and hence to cause a deposition of phosphorus, and experiment showed that after extirpation of the ovary the excretion of phosphorus fell off one-half.

*Phys. Cent. IX.

Perhaps the best known internal secretion is glycogen. This substance, made by the liver and given to the blood, is used as food by many other organs. Thanks to Hedin, Minkowsky and others, the internal secretion of the pancreas is now known to be a necessity to the organism, for if this organ is extirpated, the animal (mammal) quickly dies from diabetes mellitus. What the active substance is and whether it acts directly on the liver or through the nervous system is not yet decided. Equally important internal secretions are produced by the thyroid and thymus glands and the suprarenal capsules, the complete extirpation of any of which leads to rapid death, though life may be prolonged for a longer or shorter time by feeding the animal with the missing organ or injecting its extract into the system. Very striking is the effect of non-development or over-development of the thyroid on the cranium. The low broad skull of the cretin forms a distinct type, and the rapid change in physiognomy in patients suffering from goitre after the reduction of the thyroid or the injection of thyroidin is well known. According to Brown-Séquard, the fatal results of extirpation of the kidney are due not to poisoning by urea, but to the lack of an internal kidney-secretion essential in some way to the organism. There can be no doubt that the muscles also form such a secretion, for it has been shown that the excitation of the breathing center on muscular activity is the consequence of some chemical substance given by the muscle to the blood. Perhaps a similar secretion is the ammonia manufactured by the mucous membrane of the stomach and carried to the liver, there to be elaborated into other products. Although such substances have not yet been

isolated from the brain, salivary glands and some other organs, there seems good reason to believe that even these furnish to the blood substances peculiar to them.

It is, therefore, highly probable that all organs have besides their obvious function, a hidden function, in the maintenance, by means of their internal secretions, of the metabolic equilibrium of the body. Further, many of these secretions are absolutely essential to the life of other organs, and in certain cases, as in the thyroid and reproductive organs, they are necessary to the development of organs apparently not in any way connected with them. There can be little doubt that one of the prime uses of the blood is as a distributing agent of these substances, and that its coördinative function is one of its most important offies.

We are thus led to a possible explanation, along these lines, of the organic unity of organisms unprovided with a nervous system. It is highly probable that the internal secretions play an important rôle in the correlation of parts in the higher organisms. It is possible that this rôle becomes the principal one in case of the developing embryo or of organisms like the plants which have no nervous system. The internal secretions are also of interest in their bearing on the correlation of variations.

If an organ in one part of the organism depends in any manner upon the internal secretion of some other organ we may understand how the increased developement of the one may lead to an increased development of the other, though apparently in no way connected with it. Thus we could see how variations have arisen and how they have been perpetuated until they are themselves useful. Many organs, the beginnings of which could hardly have been useful enough to be acted upon by natural selection, may have been developed because they are correlated by means of their internal secretions with other organs which are useful. It would also be clear why certain organs or groups of organs vary together. If such organs are mutually interdependent in the manner indicated, then the diminution of one necessarily means the diminution of another and another and so on. In certain cases the diminution of one may lead to the growth of another organ. This is, perhaps, most strikingly seen in the case of castrated cattle, which are proverbially large boned and fat, the growth of the bone being correlated with the diminution of the internal secretion of the sexual organs. In another case, where two organs were dependent on the internal secretion of some third, the suppression of one of the two might lead to a compensatory growth in the other.

That the internal secretions play a part in embryonic differentiations seems very probable. Striking examples of their importance in the later stages of development are afforded by the thyroid and the reproductive glands, already referred to. Lack of development of the thyroid hinders the development of the cranium and the whole body. If cretins be fed on thyroid they increase both in size and intelligence. The development of the sexual organs is essential to that of many other so-called secondary sexual characters. The same may very well be the case in the embryo. Thus an organ called into being by a previous organ may in its turn determine, through an ininternal secretion, the development of a succeeding organ ; and we should here have an explanation of the persistence of rudiments, or the temporary appearance of glands and organs which later disappear and seem to fulfill no function whatever. They may be necessary to the organism through their internal secretions, which give the necessary stimuli to the development of other organs which are permanent.*

*See note at end.

I would suggest also that the internal secretions may possibly give the explanation of the modifying influence of the male element on the surrounding mother-tissue forming the fruit in plants. Darwin notes many cases of hybrids in which the fruit, though composed of purely maternal tissue, nevertheless plainly shows paternal characters. He explained these cases by the wandering of the pangens. It is not impossible that his 'pangens,' not only here, but in other cases, may be nothing else than the internal secretions. There can be little doubt, furthermore, that the internal secretions from the fœtus play a very considerable part in the modification of the maternal organism during pregnancy.

The foregoing suggestions are difficult of proof, but they do not seem to me inherently improbable, since it is altogether unlikely that the metabolic coordination, which certainly exists in the adult organism, comes into being only after the close of embryonic development, and only in such organisms as possess a well developed vascular system. It is well, too, to bear these internal secretions in mind in the study of the development of organisms. Such an organ as the shell-gland of the molluscs may be of vastly greater value to the organism as a manufacturer of an internal secretion than as the maker of a protective shell.

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[NOTE: The above interesting suggestion regarding the physiological *rôle* of internal secretions in development is, as far as I know, new. It is obvious, however, that the interpretation given of rudimentary or temporary organs in development is nearly related to that of Kleinenberg, with which the author is apparently unacquainted. Kleinenberg long since held that the permanent parts of the embryo might appear and be guided in their development 'through the stimulus or by the aid' of 'rudimentary' as well as of obviously functional organs; and that 'when these (the permanent organs) have attained a certain degree of independence the intermediary organ, having played its part, may be placed on the retired list' (*Lopadorhynchus*, 1886, p. 223). Mr. Mathews' suggestion has the great merit of supplying an intelligible working hypothesis regarding the nature of the 'stimulus' or the 'aid' given by the intermediary organ, and it seems well worthy the attention of experimental embryologists.

E. B. W.]

A LAYMAN'S VIEWS ON SPECIFIC NOMENCLATURE.

ANYTHING that Dr. Hart Merriam writes is sure to be of great value. He is one of the leading mammalogists and he has laid all men interested in biology under a heavy debt by reviving the best traditions of the old-school faunal naturalist and showing that among the students of the science of life there is room for other men in addition to the section cutter, the microscopist and the histologist. There are a good many of us who look forward to the publication of his great work on the North American Mammals, including their life histories, as to something which will mark a real epoch in scientific work on this continent.

Having made this kind of preface, everyone will naturally and rightly conclude that I intend to say something in dissent from some of Dr. Merriam's views. I have just been reading his very interesting pamphlet on the smaller North American wolves, commonly called prairie wolves, or coyotes. His facts and deductions are most important; he has shown for the first time how many different races of coyotes there are, together with their inter-relationships and